Working with OGC WCS

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SEE
WHAT
OTHERS
CAN'T

Working with OGC WCS – Introduction

- The Open Geospatial Consortium (OGC) Web Coverage Service (WCS) provides an open specification for sharing coverages (aka. image/raster datasets) on the web
- WCS Core establishes three request types to serve the coverages:
  - GetCapabilities: returns XML-encoded descriptions of service properties and the coverages offered by the WCS service requested
  - DescribeCoverage: returns XML-encoded descriptions of coverages properties (such as their location in space and time) offered by the WCS service requested
  - GetCoverage: returns a coverage in a specific data format after processed by request parameters (bounding box, spatial reference, interpolation method, rows/columns, resolution, a slice in multi-dimensions etc.)

Working with OGC WCS – Overview

- ArcGIS Server side WCS support:
  - ArcGIS WCS Server exposes as an extension of an ArcGIS Image Server, Map Server, or Geodata Server (1.0.0, 1.1.x, 2.0.1)
  - ArcGIS WCS service can be consumed in 3rd party client apps. e.g. ENVI, QGIS.

- ArcGIS Client side WCS support:
  - WCS server connection and WCS layer display through ArcGIS Desktop (ArcMap: 1.0.0, 1.1.x, 2.0.1; ArcGIS Pro: 1.0.0, 1.1.x)
  - ArcGIS SDKs for customizing WCS client apps:
    - ArcGIS JavaScript APIs 3.x (1.0.0, 1.1.x, 2.0.1)
    - ArcObjects 10.x .NET/Java/C++ SDKs (1.0.0, 1.1.x, 2.0.1)
  - ArcGIS WCS client can consume WCS service hosted by 3rd party GIS server. e.g. GeoServer.

Working with OGC WCS – ArcGIS Server

- ArcGIS WCS Server is a fully compliant product (version 1.0.0, 1.1.1, and 2.0.1) and certified by OGC.

ArcGIS Enterprise 10.7	satish sankaran	Registered: 2019-03-20
KML 2.2.0		Certified: 2019-04-10
WCS 2.0 Interface Standard- Core: Corrigendum 2.0.1		Certified: 2019-04-10
Web Coverage Service 2.0 Interface Standard - Earth Observation Application Profile 1.0		Certified: 2019-04-10
Web Coverage Service 2.0 Interface Standard - XML/POST Protocol Binding Extension 1.0.0		Certified: 2019-04-10
Web Coverage Service Interface Standard - Interpolation Extension 1.0		Certified: 2019-04-10
Web Coverage Service Interface Standard - Scaling Extension 1.0		Certified: 2019-04-10
Web Coverage Service Interface Standard - CRS Extension 1.0		Certified: 2019-04-10
Web Coverage Service Interface Standard - Range Subsetting Extension 1.0		Certified: 2019-04-10
Implementation Specification for Geographic information - Simple feature access - Part 2: SQL option 1.1		Certified: 2019-04-10
Web Coverage Service (WCS) Implementation Specification (Corrigendum) 1.0.0		Certified: 2019-04-10
Web Coverage Service (WCS) Implementation Specification Corrigendum 1 1.1.1		Certified: 2019-04-10

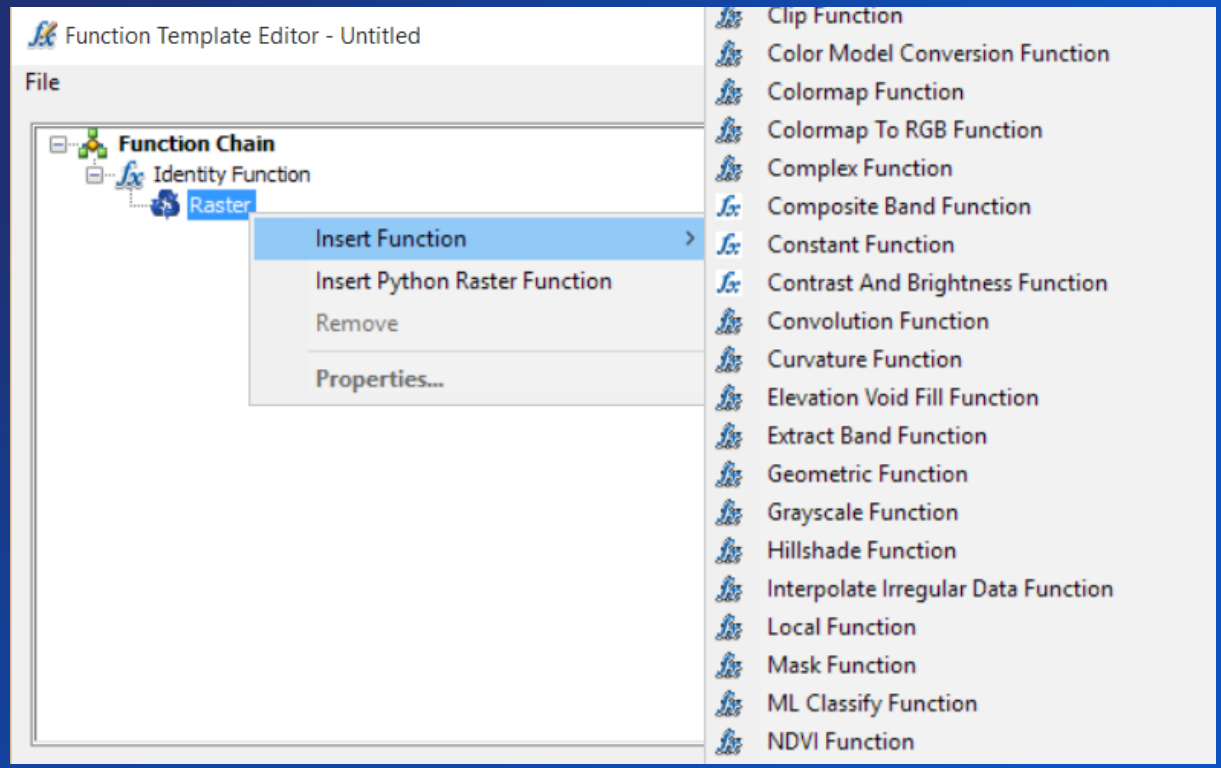
Working with OGC WCS – ArcGIS Server

- ArcGIS WCS Server is implemented through ArcGIS Image Server, Map Server, and Geodata Server
- Support versions: 1.0.0, 1.1.0, 1.1.1, 1.1.2, and 2.0.1
- Support export coverages in formats: GeoTIFF, HDF, JPEG, JPEG2000, and PNG
- Support multiple WCS 2.0.1 extensions and application profiles:
  - Service Extensions: Scaling Extension; Range Subsetting Extension; CRS Extension; Interpolation Extension
  - Protocol Extensions: KVP/GET; XML/POST
  - Application Profile: Earth Observation

Working with OGC WCS – Beyond specifications

- Raster function template as additional coverages:
  - ArcGIS WCS Server does not serve the coverages only, it also serves ArcGIS's powerful raster processing potentials at server side.

```
▼<wcs:Contents>
  ▼<wcs:CoverageSummary>
    ▼<ows:WGS84BoundingBox>
      <ows:LowerCorner>11.844983388185224 49.435255019116688</ows:LowerCorner>
      <ows:UpperCorner>11.875971639622849 49.453907101476155</ows:UpperCorner>
    </ows:WGS84BoundingBox>
    <wcs:CoverageId>amberg</wcs:CoverageId>
    <wcs:CoverageSubtype>GridCoverage</wcs:CoverageSubtype>
  </wcs:CoverageSummary>
  ▼<wcs:CoverageSummary>
    ▼<ows:WGS84BoundingBox>
      <ows:LowerCorner>11.844983388185224 49.435255019116688</ows:LowerCorner>
      <ows:UpperCorner>11.875971639622849 49.453907101476155</ows:UpperCorner>
    </ows:WGS84BoundingBox>
    <wcs:CoverageId>amberg_SharpenAndStretch</wcs:CoverageId>
    <wcs:CoverageSubtype>GridCoverage</wcs:CoverageSubtype>
  </wcs:CoverageSummary>
</wcs:Contents>
```



Working with OGC WCS – Beyond specifications

- Raster function template can chain multiple ArcGIS build-in raster functions and customized Python raster functions together.

Math

Abs
Arithmetic
Band Arithmetic
Calculator
Divide
Exp
Exp10
Exp2
Float
Int
Ln
Log10
Log2
Minus
Mod
Negate
Plus
Power
Round Down
Round Up
Square
Square Root
Times
Bitwise And
Bitwise Left Shift
Bitwise Not
Bitwise Or
Bitwise Right Shift
Bitwise Xor
Boolean And
BooleanNot
Boolean Or
Boolean Xor
Equal To
Greater Than
Greater Than Equal
Is Null
Less Than
Less Than Equal
Not Equal
ArgStatistics
Cell Statistics
Statistics
ACos
ACosH
ASin
ASinH
ATan
ATan2
ATanH
Cos
CosH
Sin
SinH
Tan
TanH

Conditionals

Con
Set Null

Correction

Apparent Reflectance
Geometric Correction
Speckle Filtering (Lee,Frost,Kuan)

Data Management & Conversion

Raster to Vector
Vector to Raster
Colormap
Colormap To RGB
Complex
Grayscale
Remap / Reclass
Spectral Conversion
Unit Conversion
Vector Field
LAS to Raster
LAS Dataset to Raster
Clip
Composite
Extract Bands
Mask
Mosaic Rasters
Rasterize Features
Reproject

Visualization & Appearance

Contrast and Brightness
Convolution
Pansharpening
Resample
Statistics and Histogram
Stretch

Interpolation

Natural Neighbor
Nearest Neighbor
Inverse Distance Weighted
Empirical Bayesian Kriging
Swath

Surface Generation & Analysis

Aspect
Curvature
Elevation Void Fill
Hillshade
Shaded Relief
Slope
Viewshed

Analysis: Density

Kernel Density

Analysis: Overlay

Weighted Sum
Weighted Overlay

Analysis: Zonal

Zonal Statistics

Analysis: Band Math & Indices

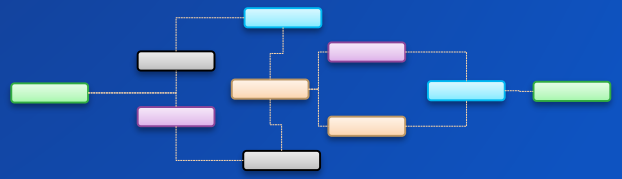
NDVI / NDVI Colorized
SAVI / MSAVI / TSAVI
GEMI
GVI (Landsat TM)
PVI
Tasseled Cap (Kauth-Thomas)
Binary Thresholding

Analysis: Image Segmentation & Classification

Segmentation (Mean Shift)
Training (ISO, ML, Support Vector Machine,Random Trees)
Classification

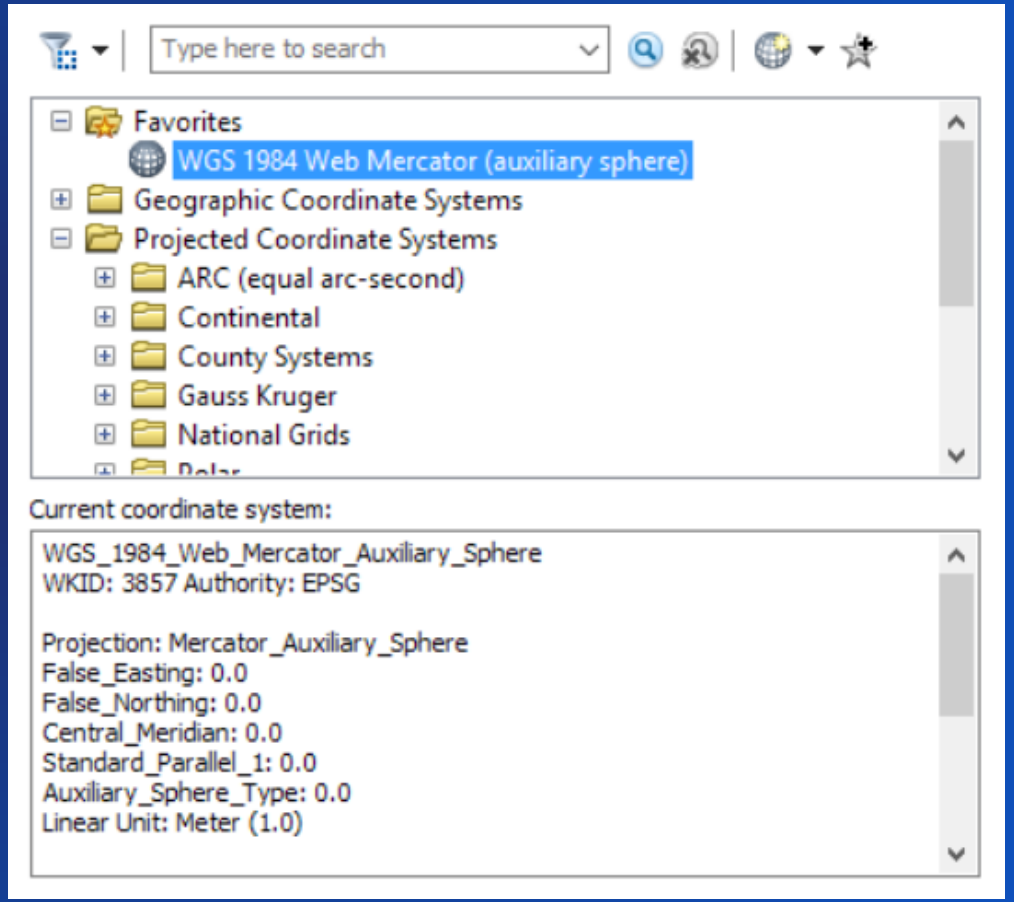
Python

Custom Algorithms



Working with OGC WCS – Beyond specifications

- More projections available:
  - Not limited to “crsSupported” inside the xml response of DescribeCoverage or GetCapabilities requests.
  - ArcGIS WCS Server integrates with ArcGIS projection engine to support all EPSG+ESRI WKID-based spatial reference reprojections (~6000 projections).



Working with OGC WCS – Beyond specifications

- Dynamic mosaicking:
  - Backed by mosaic dataset technology, hundreds of thousands of images can be served through one service, as one single mosaic, dynamically processed by server.
  - GetCoverage for any of the mosaicked rasters through, e.g.,

http://gisserver.domain.com:6080/services/myservice/ImageServer/WCSServer?IMAGES=4,5,6

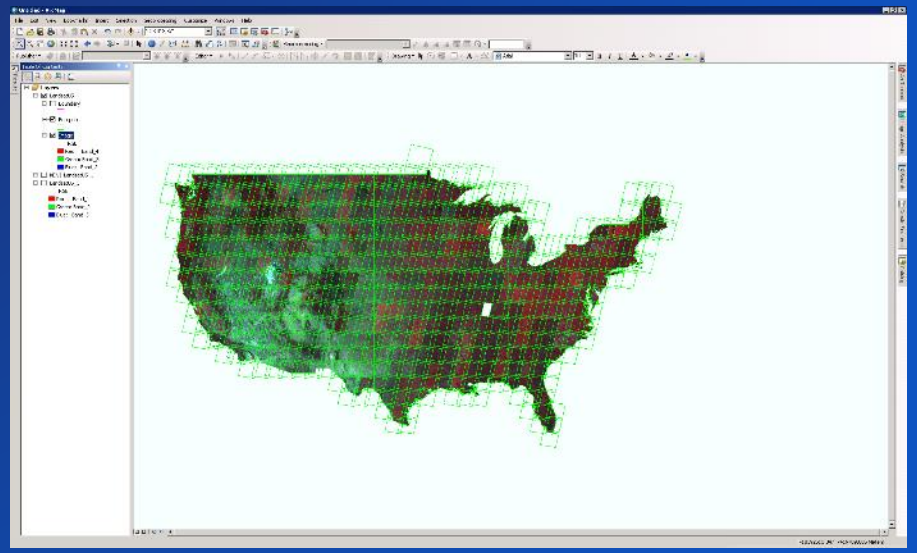
  - Easily WCS-able multidimensional data (NetCDF, HDF, GRIB) through mosaic dataset (variables, dimensions, etc).

To access a variable data at a dimension value, using, e.g.,

&timeSequence=2014-06-29T00:00:00.000Z

&rangeSubset=water_temp:nearest[StdZ[-5000]]

OBJ	Raster	Name	Variable *	Standard Time	Standard Z	•••
1	<Raster	hycom_glb_regp01.nc:water_temp:0	water_temp	5/17/2013	0	
2	<Raster	hycom_glb_regp01.nc:water_temp:1	water_temp	5/17/2013	-2	
3	<Raster	hycom_glb_regp01.nc:water_temp:2	water_temp	5/17/2013	-4	
4	<Raster	hycom_glb_regp01.nc:water_temp:3	water_temp	5/17/2013	-6	
5	<Raster	hycom_glb_regp01.nc:water_temp:4	water_temp	5/17/2013	-8	

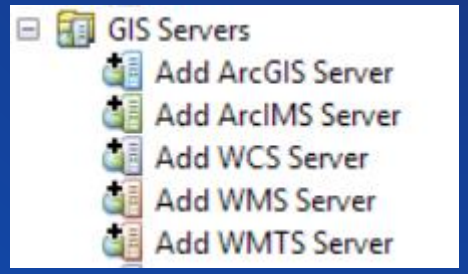


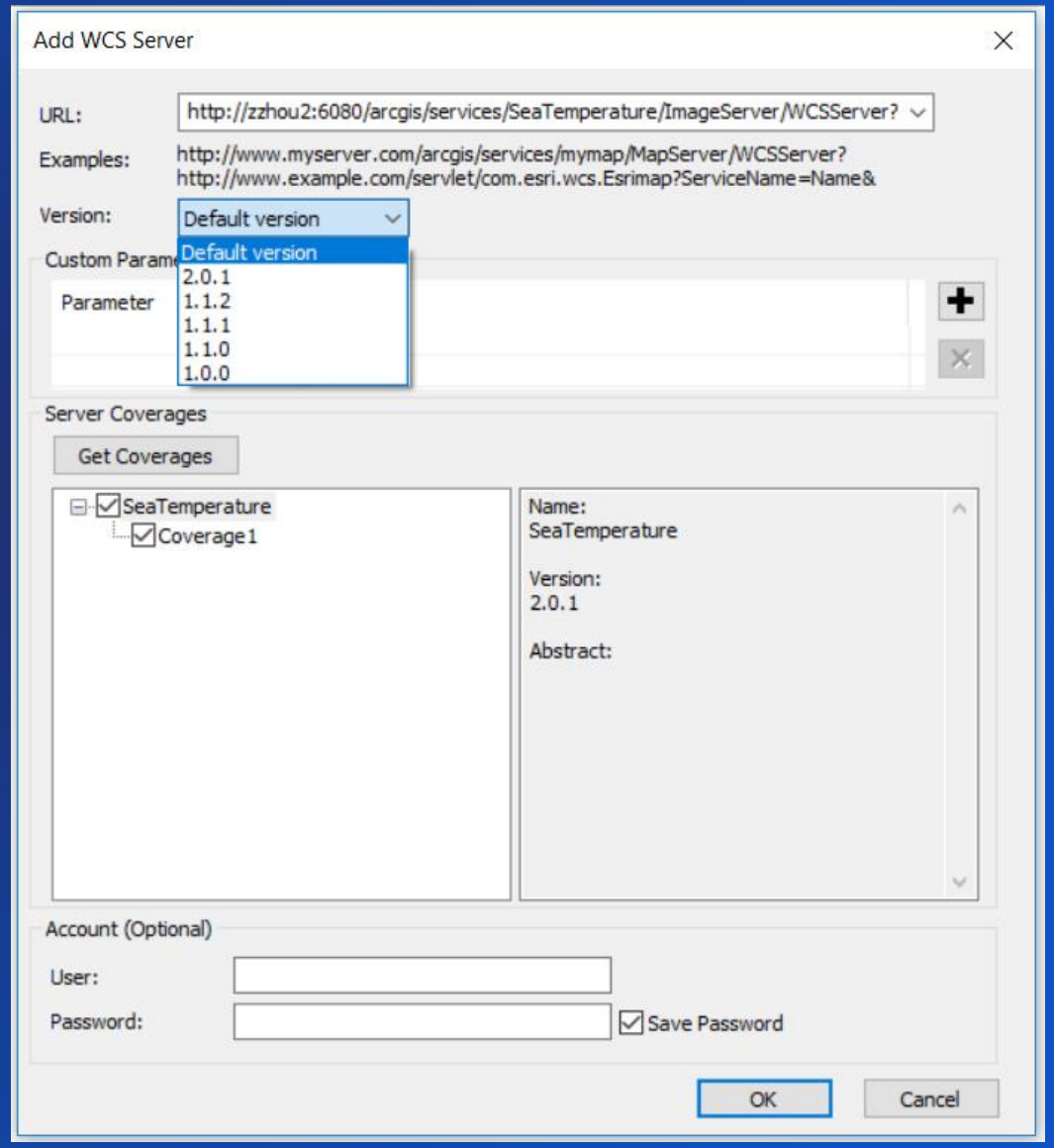
Working with OGC WCS – licensing

- Licensing:
  - GIS Server license
    - Standard – single raster datasets
    - Advanced – raster functions
  - Image Server license
    - For mosaic dataset served as WCS
- Security:
  - Inherits ArcGIS Server’s security model
  - The security for a WCS service is managed by controlling the security of its parent map, geodata, or image service. It supports token-based security and you can add a valid token in a http request for a secured WCS service. If a particular service user is denied access to an ArcGIS service coverage resource, it will not be able to access the coverage resource regardless of whether they try to consume it through SOAP, REST, or WCS interfaces.

Working with OGC WCS – ArcGIS Desktop

- Support consuming WCS in version: 1.0.0, 1.1.0, 1.1.1,1.1.2, and 2.0.1 (ArcMap only)
- Support basic authentication through http/https
- Support optional parameters that can be used by GetCoverage as defined by the WCS server
- Support displaying coverage properties from DescribeCoverage





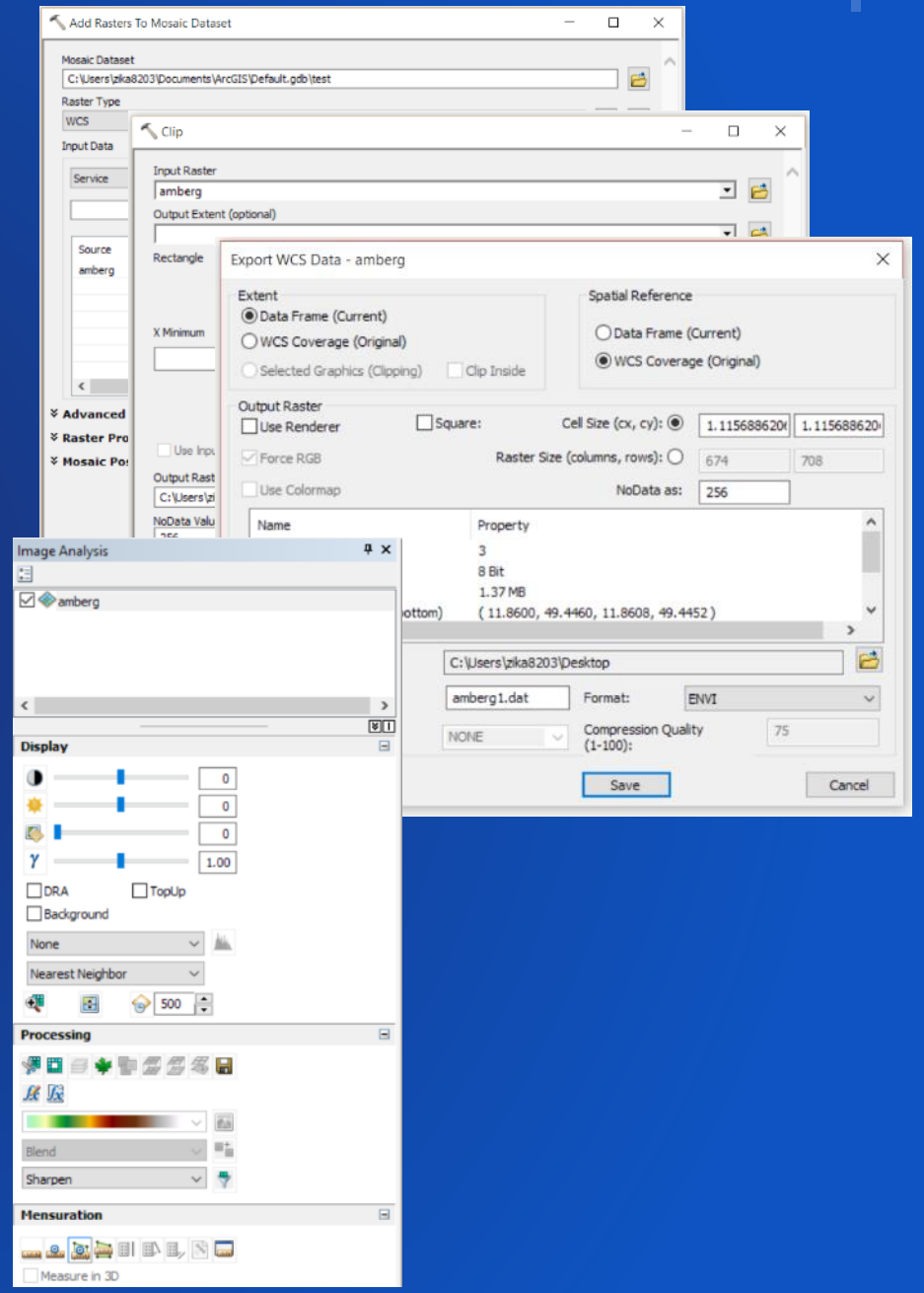
Working with OGC WCS – ArcGIS Desktop

- Alternatively, you can directly drag & drop to display files with .wcs extensions.

```
<WCS_GDAL>
  <ServiceURL>http://zzhou2:6080/arcgis/services/SeaTemperature/ImageServer/WCSServer</ServiceURL>
  <CoverageName>coverage1</CoverageName>
  <Version>2.0.1</Version>
  <Format>image/tiff</Format>
  <Subset>StdTime(2014-06-29T00:00:00Z);StdZ(-5000)</Subset>
  <RangeSubset>water_temp</RangeSubset>
  <Interpolation>http://www.opengis.net/def/interpolation/OGC/1/nearest-neighbor</Interpolation>
  <NoGridAxisSwap>True</NoGridAxisSwap>
</WCS_GDAL>
```

Working with OGC WCS – ArcGIS Desktop

- After importing the WCS layer into the ArcMap/Pro:
  - Support identifying pixel values of coverage
  - Support displaying coverage in various new renders and raster function templates
  - Support displaying coverage in various data frame projections supported by ArcGIS, including all EPSG coordinate systems; even if WCS Server doesn't have them in supported CRSs
  - Support converting coverage to various raster formats supported by ArcGIS; even if WCS Server doesn't have them in supported formats
  - Coverages can be consumed throughout ArcGIS, in Geoprocessing tools, Image Analysis Window, mosaic datasets etc, just like any other local raster datasets



Working with OGC WCS – ArcGIS JavaScript API

- Available in ArcGIS JavaScript API 3.18+. (not supported in 4.x yet)
- Support accessing and consuming WCS in versions: 1.0.0, 1.1.0, 1.1.1, 1.1.2, and 2.0.1.
  - For version 2.0.1, it supports servers that support GEOTIFF coverage and implements the following extensions: Scaling, Interpolation, Range Subsetting, CRS, and KVP/Get.
- Class: esri/layers/WCSConnection
  - A helper class to discover available coverages in an OGC Web Coverage Service
- Class: esri/layers/WCSCoverageDescription
  - Models the coverage properties offered by the WCS Server. This class normalizes the variations across different versions of WCS Coverage Description
- Class: esri/layers/WCSLayer
  - Retrieves coverage (raster) data and renderers it on the client app.

Working with OGC WCS – ArcObjects SDKs

- WCSLayer CoClass:
  - WCSLayer accesses a coverage served through an OGC WCS service and visualize the pixels of the coverage in ArcGIS.
  - A WCSLayer supports most of the functions that a RasterLayer provides. The display can be manipulated by accessing through IRasterLayer interface as all other raster layers.
- IWCSLayer Interface:
  - IWCSLayer Interface provides access to the properties and methods of WCSLayer.

[C#]

```
 //WCS service uniform resource locator (URL).
string URL="http://liaoning1/arcgis/services/dem/mapserver/wcsserver?";

//Create WCSLayer from the first coverage.
IWCSLayer wcslayer=new WCSLayerClass();
wcslayer.Create(URL, "1", "1.0.0");

//Access raster.
IRasterLayer rasterlayer=(IRasterLayer)wcslayer;
IRaster2 raster=(IRaster2)rasterlayer.Raster;

//Access raster dataset.
IRasterDataset rasterdataset=raster.RasterDataset;
```

	All	Description
	CoverageName	The WCS coverage name.
	Create	Creates a WCS layer from given WCS coverage definition.
	Refresh	Refreshes layer once any of layer properies has changed.
	ResamplingType	The request resampling (interpolation) type.
	ServiceURL	The WCS service URL.
	Timeout	The request timeout value in seconds.
	Version	The WCS service version.

Working with OGC WCS – Compare with ArcGIS Image Service

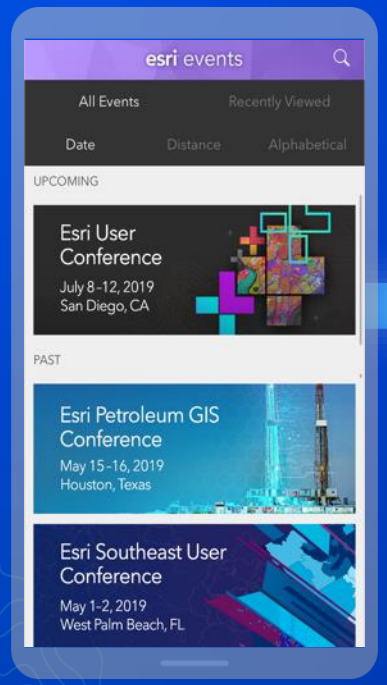
Feature	WCS (rectified coverage)	Image Service
Dynamic mosaicking	Basic support as defined by service	Full support with client side control
On the fly processing	Basic support as defined by service	Full support with on demand customization
Coverage delivery	Basic support as defined by spec	Better compression (LERC)
Variables, dimensions	Not flexible (2.0.1 requires fixed offset)	Fully compatible with NetCDF convention
Cataloging	N/A	Query and sort by attribute, geometry in millions of scenes.
Information model	Basic modeling of raster dataset	Comprehensive information model with dedicated auxiliary info support: multidimensionalInfo, colormap, attribute table, histograms, wavelength, transformations, metadata etc.
Data exploratory API	N/A	Mensuration, Get Samples, Compute Stats & Histograms, Project, Identify, Query
API	GET/KVP; POST/XML	REST/SOAP

Working with OGC WCS – Road ahead

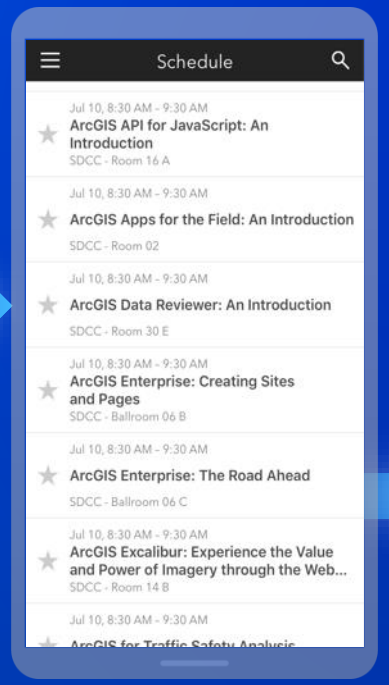
- On current plan:
  - Server side:
    - Support more application profiles (e.g. MetOcean-WCS).
  - Client side:
    - Support multi-dimensional wcs layer in client applications.
    - Better WCS 2.0.1 support through subset parameters.
    - Support WCS layer type items in ArcGIS Online/Portal for ArcGIS.

Please Share Your Feedback in the App

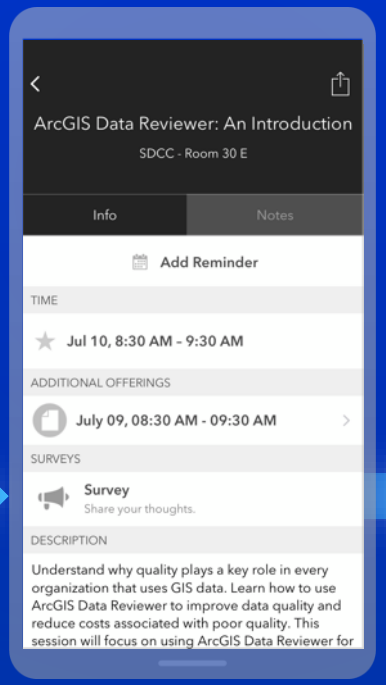
Download the Esri Events app and find your event



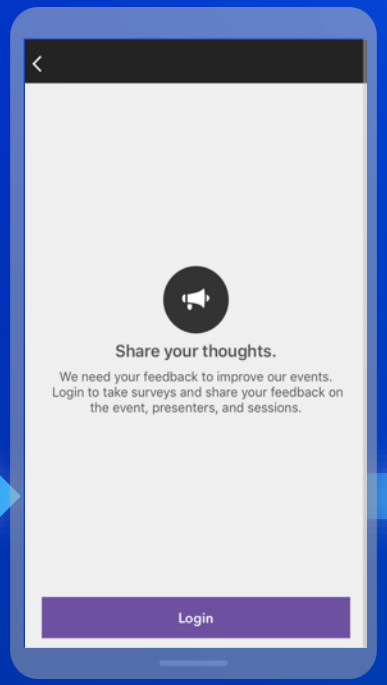
Select the session you attended



Scroll down to “Survey”



Log in to access the survey



Complete the survey and select “Submit”